



Short report

Patterned genital injury in cases of rape – A case–control study



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ABSTRACT

A pattern of genital injury that separates trauma seen in sexual assault cases from trauma seen following consensual sexual intercourse has been a matter of debate. This study aimed at clarifying the question by eliminating as many confounders as possible in a prospective, case-control setup. A total of 98 controls and 39 cases were examined using the naked eye, the colposcope and toluidine blue dye followed by colposcopy. The overall frequency of having at least one lesion was strikingly similar in the two groups, but cases had significantly more abrasions, a trend towards more haematomas and a higher frequency of multiple lesions. Cases had a higher frequency of lesions in locations other than the 6 o'clock position. Our data suggests that cases have larger, more complex lesions. In conclusion, this study has confirmed the existence of different patterns of genital lesions. Background data for detection of genital lesions using the three most commonly used techniques is provided. These results will aid in the interpretation of findings seen when examining sexual assault victims.

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1. Introduction

The existence of a pattern of genital injury distinguishing trauma seen in rape cases and trauma seen following consensual sexual intercourse has been a matter of debate. Typical different patterns was suggested by Slaughter et al. in 1997 i.e. multiple genital lesions at multiple locations seen in rape victims as opposed to single lesions in the posterior forchette following consensual sexual intercourse.¹ This pattern has to some degree been confirmed in adults² and adolescents,³ whereas a third study could not confirm such a pattern.⁴ A more detailed description of a pattern would aid the medico-legal expert when giving evidence based testimony in court proceedings.

This study aimed to describe the pattern of injury in a prospective, controlled setting using the three most commonly used objective measures worldwide – the naked eye, colposcopy and toluidine blue dye followed by colposcopy.^{5,6}

2. Methods

The present study was part of a larger study conducted at the Southern Denmark Sexual Assault Referral Centre (SDSARC) as

collaboration between the Institute of Forensic Medicine, University of Southern Denmark and the Department of Gynaecology and Obstetrics, Odense University Hospital. Data and results regarding the control group has been published in detail.⁶ The SDSARC is a 24 h service that receives victims of sexual assault of both sexes, ≥15 years of age, with or without prior police contact. It is staffed with specialized nurses (not forensic nurses) from the gynaecological department and doctors specializing in forensic medicine.

2.1. Participants

Female cases were included consecutively over a two year period (August 2009 to July 2011). Adolescents, 15–17 years of age were only asked to participate if a parent or legal guardian was present. Controls were recruited over a two months period (Spring 2010) among students at the University College Lillebaelt, Health and Social Sciences. An e-mail with information was sent to all students (approximately 1200) through the intra-net of the school. The first 110 women responding were included and inclusion was then closed due to limitations in investigative capacity. All controls were instructed to have sexual intercourse in accordance with their normal routine, including penile penetration as a must within 48 h of the examination. Just before the examination, they answered a

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questionnaire with questions concerning gynaecological matters, sexual habits and the nature of their latest intercourse.

2.2. Clinical investigations

Examinations were performed by five physicians (registrars) from the Institute of Forensic Medicine, University of Southern Denmark, all experienced in the examination and evaluation of findings in sexual assault victims. The colposcope used was a Zeiss 150 (Carl Zeiss, Meditec, Inc. Dublin, California). The toluidine blue dye was applied using the Forensic Blue Swabs® (National Forensic Nursing Institute (NFNI), Inc. USA), and applied according to their guidelines. Toluidine blue dye is taken up by exposed nucleated cells, leaving them blue, whereas it is easily washed off intact mucosa.

The examinations followed the same strict routine sequence:

1. Naked eye examination of external genitalia. Recording of all findings; positive or negative.
2. Colposcopy of the external genitalia. Recording of all findings, positive or negative. Digital photography using the integrated camera of the colposcope. Photographic data was not included in this paper.
3. Toluidine blue dye was applied to the external genitalia and removed with 1% acetic acid after drying as recommended by NFNI.⁷
4. Point 2 was repeated.
5. Inspection of the vagina and cervix using speculum and colposcope. Findings were noted.

Victims of rape had trace evidence secured at appropriate times during the above routine.

2.3. The nature of lesions

Three types of lesions were described in accordance with international literature on the subject⁸ lacerations, abrasions and haematomas. More ambiguous lesions, such as redness or swelling of the TEARS (Tear, Ecchymosis, Abrasion, Redness and Swelling) classification were not included, as they were considered ambiguous, and neither was a distinction between raised and confluent contusions made, as this was considered equally ambiguous in the soft tissue of the external genitalia.

1. Laceration: discontinuity of epidermis and dermis. Often caused by blunt force such as tearing, crushing or overstretching. Takes up toluidine blue dye if not covered by fibrin.
2. Abrasion: traumatic exposure of lower epidermis or upper dermis. The outermost layer of the skin is scraped away from the deeper layers. Often caused by lateral rubbing or sliding against the skin in a tangential rather than a vertical manner. Does only take up Toluidine blue dye if the upper dermis is exposed.
3. Contusion/haematoma/bruise: extra-vasation of blood in tissues below an intact epidermis. Often caused by blunt force. No distinction between the three was made.

Number of lesions and position (labia, 6 o'clock position, hymen, vaginal wall or cervix) was noted.

2.4. Frequency of lesions

Frequency of lesions is reported as the number of women having at least one lesion. The frequency is given for each of the three examination techniques and each of the three types of lesions.

2.5. Location of lesions

The following locations were used: (1) 6 o'clock position, defined as the entire commissura posterior from the outer hymenal rim, including the fossa navicularis and the posterior fourchette down to the perineal body. (2) Labia minora, including both sides of the labia, (3) Vestibule, defined as the area outside the hymenal rim, between the labia and including the urethral orifice, (4) Clitoral hood, defined as the commissura anterior, clitoral hood and glans clitoris, (5) Hymen, defined as the hymenal tissue only, (6) Vagina, defined as the vaginal wall from behind the hymen and backwards and (7) Cervix.

2.6. Statistical analysis

All data were entered in the EpiData software system securing a simple and certified double entry (www.epidata.dk). Data were entered twice, once by investigators and once by secretaries. Discrepancies were caught in the data check mode and corrected according to the original questionnaires. Analysis of data was performed using the STATA (version 10.1) software package (www.stata.com). Frequencies were given as proportions with a 95% confidence interval (c.i.) calculated using the exact probabilities of the Binomial distribution. Categorical data were analysed using the Fisher's exact test for significance. As for non-categorical data, normality was not assumed and data were analyzed using the Mann–Whitney *U*-test for significance. To investigate the influence of more than one explanatory variable, logistic regression modelling and a technique of stepwise reduction in the number of non-significant variables was used. Significance level was set at 95%.

2.7. Ethical considerations

The study was approved by the Medical Research Ethics Committee of Southern Denmark. Written consent was obtained from all participants. Full anonymity was secured by anonymous e-mail addresses for communication and an anonymous, secured storage code for data and photographs. If any significant medical conditions were discovered, the woman was referred to the gynaecologist on duty.

3. Results

3.1. Study population

A total of 71 women were seen by a forensic physician at SDSARC in the inclusion period. Of these, 32 were excluded: 12 did not wish to participate, 9 were minors accompanied by other than a legal guardian, 8 were excluded due to psychological issues such as psychiatric disease, mental retardation or severe intoxication, and 3 cases due to technical problems. All cases, including minors, had previous sexual experience. After inclusion it was revealed, that 12 of the 110 controls did not fulfil the inclusion criteria of vaginal intercourse within 48 h prior to examination. The results of these women did, however, not differ from the rest of the women and data could be excluded from the analysis without affecting the results. In the case group, three had more than 48 h but less than 72 h since the non-consensual intercourse and two had no clear recollection of time. The rest had less than 48 h since intercourse. All women in the control group were Caucasian. In the case group, two were of Inuit descent, one Middle Eastern, and the rest were Caucasian. Table 1 summarizes the gynaecological history of the women and the nature of their latest intercourse.

Table 1
Intercourse characteristics and sexual practices of the two groups.

	Controls Inclusion (n = 98)	Cases Inclusion (n = 39)
Age	23 (22.3–23.7) ^a	26 (23.4–29.4) ^a
Hours since intercourse	17 (16–20) ^a	10 (6–18) ^a
Alcohol intake ^b	0	25 (61%)
Narcotic ^c	0	0
Unemployment	0	20 (51%)
Childbirth (vaginal/caesarean)	11 (11%)/1(1%)	11 (28%)
STD in history ^d	54 (55%)	12 (30%)
Sexually active ^e	100%	53%
Contraception		
Oral	78 (80%)	9 (23%)
Condom	13 (13%)	0
Other	9 (9%)	11 (28%)
None	10 (20%)	20 (51%)
Use of tampon <48 h of examination	5 (5%)	2 (5%)
The latest intercourse:		
Ejaculation	62 (63%)	11 (28%)
Use of fingers	61 (61%)	11 (28%)
Use of lubricant	9 (9%)	0
Use of object	4 (4%)	2 (5%)
Use of condom	12 (12%)	0
Self-defined nature of latest intercourse ^f		
Soft	8 (8%)	3 (8%)
Normal	84 (86%)	12 (31%)
Rough	6 (6%)	18 (46%)

^a Data presented as median (95% confidence intervals).^b Self reported alcohol intake <24 h.^c Self reported intake of illicit drugs <24 h.^d Chlamydia, condylomas, herpes or gonorrhoea. One had more than one STD.^e >1 intercourse in last month.^f Participants could only chose between the three options (undefined in questionnaire).

3.2. Frequency of lesions

The results are summarized in Table 2. Using a logistic regression model none of the following factors: (1) case or control, (2) time since intercourse, (3) use of condoms, (4) use of lubricants, (5) usual pattern of sexual activity, (6) roughness of intercourse, (7) previous vaginal deliveries or (8) age had any significant influence on the presence or type of lesions irrespective of type of examination (data not shown). No variable showed borderline significance or trend towards correlation.

Table 2
Proportion of women presenting with at least one of a particular lesion.

	Controls Inclusion (n = 98)		Cases Inclusion (n = 39)		P-value ^b
	n	Proportion ^a	n	Proportion ^a	
Naked eye					
Laceration	31	31% (22.6–41.8%)	11	28% (15.0–44.9%)	0.84
Abrasion	2	2% (0.2–7.2%)	5	13% (4.3–24.4%)	0.01
Haematoma	2	2% (0.2–7.2%)	3	8% (1.6–20.9%)	0.09
Any lesion	34	34% (24.4–43.9%)	14	36% (21.2–52.8%)	1.00
Colposcope					
Laceration	41	42% (31.9–52.2%)	14	36% (21.2–52.8%)	0.58
Abrasion	5	5% (1.7–11.5%)	6	15% (5.8–30.5%)	0.04
Haematoma	3	3% (0.6–8.7%)	4	10% (2.8–24.2%)	0.08
Any lesion	48	49% (38.7–59.3%)	19	49% (32.4–65.2%)	1.00
Toluidine Blue					
Laceration	49	50% (39.7–60.3%)	15	38% (23.2–52.8%)	0.26
Abrasion	7	7% (2.9–14.2%)	6	15% (5.8–30.5%)	0.19
Any lesion	52	52% (41.7–62.2%)	20	51% (34.8–67.6%)	0.85

Bold indicates statistical significance, $p < 0.05$.^a Data presented as percentage (95% confidence intervals).^b Fisher's exact.**Table 3**
Proportion of women presenting with more than one lesion of any type.

	Controls Inclusion (n = 98)		Cases Inclusion (n = 39)		Odds ratio	P-value*
	n	Proportion ^a	n	Proportion ^a	Case vs. Control	
Naked eye	4	4% (1.1–10.2%)	10	26% (13.0–42.1%)	8.1 (2.36–27.78)	0.001
Colposcope	9	9% (4.3–16.7%)	13	33% (19.1–50.2%)	4.9 (1.95–12.86)	0.001
Toluidine blue	20	20% (12.9–29.7%)	13	33% (19.1–50.2%)	1.9 (0.85–4.46)	0.125

*Fisher's exact. Bold indicates statistical significance, $p > 0.05$.^a Data presented as percentage (95% confidence intervals).

3.3. More than one lesion

A large proportion of the women had more than one lesion. This is defined as having two or more different lesions or two or more of the same kind, regardless of location. The data is summarized in Table 3. Only one of the above mentioned eight explanatory variables, i.e. being a case or not, was significantly correlated ($p = 0.001$) to having more than one lesion (naked eye and colposcope). No variable showed borderline significance or trend towards correlation.

3.4. Location of lesions

The 6 o'clock position was the most common location of lesions in all situations. However, controls had a significantly higher frequency of lesions in the 6 o'clock position than cases when using the naked eye and toluidine blue dye. Inversely, the cases had significantly higher frequency of lesions on the labia than controls when using colposcope and toluidine blue dye. The remaining locations were too rarely injured to base conclusions on the results. The data is presented in Table 4. Furthermore significantly more cases than controls had a lesion in another location than the 6 o'clock position, using colposcopy ($p = 0.007$, Fisher's exact) and toluidine blue dye ($p = 0.017$, Fisher's exact). None of the investigated women had lesions in the vagina or cervix.

Table 4
Injury location. Distribution in case and control group.

	Controls presenting with a lesion		Cases presenting with a lesion		P-value ^b
	n	Proportion ^a	n	Proportion ^a	
Naked eye	34		14		
6 o'clock position	29	85% (68.9–95.0%)	6	43% (17.7–71.1%)	0.005
Labia	3	9% (1.9–23.7%)	4	29% (8.4–58.1%)	0.17
Vestibule	1	3% (0.1–15.3%)	2	14% (1.8–42.8%)	0.20
Clitoral hood	2	6% (0.1–19.7%)	2	14% (1.8–42.8%)	0.57
Hymen	1	3% (0.1–15.3%)	1	7% (0.2–33.9%)	0.50
Colposcope	48		19		
6 o'clock position	36	75% (60.4–86.4%)	11	58% (33.5–79.7%)	0.24
Labia	11	23% (12.0–37.3%)	10	53% (28.9–75.6%)	0.04
Vestibule	3	6% (1.3–17.2%)	3	16% (3.4–39.6%)	0.34
Clitoral hood	2	4% (0.5–14.2%)	2	11% (1.3–33.1%)	0.32
Hymen	1	2% (0.1–11.1%)	1	5% (0.1–26.0%)	0.49
Toluidine blue	52		20		
6 o'clock position	42	81% (67.5–90.4%)	11	55% (31.5–76.9%)	0.04
Labia	16	31% (18.7–45.1%)	15	75% (50.9–91.3%)	0.001
Vestibule	4	8% (2.1–18.6%)	4	20% (5.7–43.7%)	0.21
Clitoral hood	2	4% (0.5–13.2%)	2	10% (1.2–31.7%)	0.31
Hymen	1	2% (0.1–10.3%)	1	5% (0.1–24.9%)	0.48

Bold indicates statistical significance, $p < 0.05$.^a Data presented as percentage (95% confidence intervals).^b Fisher's exact.

4. Discussion

This study is, to our knowledge, the first prospective, case-control study of female genital lesions seen after sexual intercourse. It is also the first study to report results using all three investigative methods in common use around the globe, making the results useful in all settings. We confirmed the differences in genital lesions seen following rape and consensual sexual intercourse proposed in earlier papers.^{1,2,4,5} The overall frequency of having one or more lesion of any kind was strikingly similar between groups, but cases had more complex findings with a higher frequency of abrasions, haematomas, and multiple lesions compared to controls. However, differences were only significant using the naked eye or colposcopy, whereas results using toluidine blue dye did not reach significance. Cases had a higher frequency of lesions in locations other than the 6 o'clock position, significant when using colposcopy and toluidine blue dye.

Previous studies that compared frequencies of lesions were different in design making results partly incomparable. Jones et al.³ found equal high frequencies (85% vs. 73%) in a retrospective study of adolescents using colposcopy and toluidine blue dye. Slaughter et al.¹ found unequal frequencies (68% vs. 11%) in a retrospective study, using colposcopy and toluidine blue dye, with an inhomogeneous control group that included both children/adolescents and women withdrawing their rape complaint. McLean et al.⁴ found lower frequencies (23% vs. 6%) in a retrospective study using the naked eye and a control group in which the majority of women were 30 years or older. Anderson et al.² found equal frequencies (32% vs. 30%) in a retrospective study, using colposcopy and toluidine blue dye. The TEARS classification was used by all but McLean et al. Our results are comparable with the relatively high frequency of lesions and similarity between groups seen in some of the studies.

The finding of a higher frequency of multiple lesions among cases confirms results of three studies,^{1–3} whereas McLean et al. found that three of four controls with a lesion had more than one. This discrepancy could be due to small sample size.

The location and nature of lesions is an important factor when defining a pattern of injury. Terminology of both nature and location of injury is confusing and unclear definitions render much literature incomparable with regards to these issues. We have in this article both clarified and simplified terminology. The female genital anatomy varies a great deal⁹ and many women do not have 'textbook genitals' with easily recognizable structures, and at the same time, many lesions in the posterior midline covers more than one finite anatomical area. Our data shows that one can view genital lesions as 6 o'clock position lesions and lesions at other positions. Our study confirms and extends the results of other studies. We found the 6 o'clock position prominent in both groups but significantly more so in the control group and we found significantly more cases than controls with injury of the labia minora, which is in accordance with other studies in the field which used toluidine blue dye.^{1–3} We found that the difference was only a trend when using the naked eye in accordance with McLean et al.⁴ We did not find lesions in the vagina or on the cervix as reported by other studies. This is not due to lack of visualisation. One possible explanation is small sample size, which is supported by the relative small numbers reported by other studies; another is a possible overlap between the definition of vagina and vestibule.

Our results regarding women with more than one lesion were not significant with the toluidine blue dye method. This fact indirectly suggests that cases had larger lesions, because many controls had minute lesions visible after enhancement only, whereas cases had more lesions visible to the naked eye. This explains the OR of

8.1 for having multiple lesions seen with the naked eye vs. the OR of 1.9 when using toluidine blue dye.

The similarities and discrepancies between groups could be due to a factor of the individual woman that may predispose to lesions during intercourse, just more prominent if the intercourse is non-consensual. This theory of individual vulnerability is supported by the fact that significant racial differences in frequencies of lesions following rape has been described,^{10,11} suggesting that skin type has an influence. The theory is also supported by the large variability of the size of female external genitalia. In a study by Lloyd et al.⁹ of 50 women a great variation was described, amongst others the vagina length varied from 6.5 to 12.5 cm, distance between clitoris and urethra from 1.6 to 4.5 cm and the length of the labia minora from 2.0 to 10.0 cm. The variations were independent of race, age or parity. In other words, the same fraction of women could be predisposed to genital lesions due to for instance skin type and anatomy of the genitalia, but will have more severe lesions in case of rape.

The control group is more homogeneous than the case group also when it comes to the actual sexual intercourse. Among the cases could be women passing a false or unfounded allegation of rape and thus having experience either consensual intercourse or no intercourse at all. If so, there could be a bias towards a lower frequency of lesions in the case group. We have in the present study aimed at limiting confounding by the use of a prospective setup with the same investigators in the same settings and time period and by controlling for possible confounding such as age, parity and the use of condoms. Limitations of the study are a high exclusion frequency of cases, whose influence cannot be controlled for, as well as the lack of knowledge of police investigations of cases, which could reveal important information. Another relevant limitation is the lack of control for penis size and erectile dysfunction of the male. It is impossible to obtain valid information on penis size in a study of rape victims, as the male is out of reach of the investigators for practical and ethical reasons, but one can probably assume that differences will even out in large sample sizes. Sexual dysfunction of male sex offenders has been described in literature to be a factor in 8.3% and 16%.^{12,13} However, Jones et al.¹² did not find any difference in prevalence of genital injury in a large sample of 569 cases with or without erectile dysfunction.

5. Conclusion

In this prospective case-control study of genital lesions following non-consensual and consensual sexual intercourse, we have confirmed different patterns of lesions. A single laceration at the 6 o'clock position is the most common finding in both groups, but any other positive finding was more common in the case group. Cases had more complex lesions with a higher frequency of abrasions, haematomas and multiple lesions and a higher frequency of lesion in other locations than the 6 o'clock position than seen in controls. Our data indirectly suggests that cases have larger lesions than controls. Based on these findings we propose the theory that, when looking at sexual assault, the genital lesions of value are lesions that are large enough to see with the naked eye and lesions other than a laceration in the 6 o'clock position.

We have shown that different investigative techniques give different results and that no technique in itself is superior when distinguishing trauma patterns.

These results will aid in the interpretation of findings seen when examining sexual assault victims. Interpretation is still a complicated task, but as more evidence on the subject emerges more precise conclusions can be made.

Ethical approval

The study was approved by the Medical Research Ethics Committee of Southern Denmark.

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Conflict of interest

The authors of this paper hereby declare that we have no conflict of interest regarding the present study.

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